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SPACE

No. 5

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USSR REPORT

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SOYUZ-T MISSION CLAIMED A SUCCESS

Automatic Systems Function Reliably

Moscow TRUD in Russian 27 Mar 80 p 5

[Article by I. Melenevskiy: "Soft Landing"]

[Excerpt] At our request Deputy Flight Director V. Kravets commented on various aspects of the three-month "Soyuz-T" mission:

"The vehicle functioned with great precision. During the 100 days that the ship was in orbit, there was not one breakdown. The reliability of the systems was largely due to the computer complex. It can be said that its presence on board proved to be a strict control. Any difficulty in the command, even the smallest imprecision, was instantly settled. The computer let us know of every error, and provided the correction.

"I remember that one day the computer did not agree with the orientation proposed by the ground command. In fact, it turned out that the variant proposed by the computer was, indeed, preferable. We accepted it without discussion. This situation was, of course, exceptional, but it made it clear just how highly developed the navigational capabilities of a spacecraft can be with the introduction of the computer. True, from now on the flow of information from earth to "Soyuz-T" will greatly exceed that for any other previous flights. That is to say, whereas before the number of commands during a communications session reached 20-25, now there are closer to 100. But the automated systems can deal with this increased volume."

"Soyuz-T" landed according to the same flight scheme as that developed for past spacecraft. There was only one difference: in orbit before the descent the crew compartment was separated from the descent module. This made it possible to save up to 10% in fuel.

And thus, "Soyuz-T" is now on the earth. Because of the increased thrust of the soft landing engines, the vehicle descended slower than its predecessors. "Soyuz-T" carries with it all the information on its 100 days of work in space. The most important stages of this operation are tape-recorded. Now designers and scientists must go over the ship and carefully study the materials on its orbital operations. It won't be long until "Soyuz-T" carries a crew into orbit.

The Computer: The Brain of Soyuz-T

Moscow PRAVDA in Russian 25 Mar 80 p 6

[Article by V. Gubarev: "A Space University"]

[Excerpts] The "brain" of the ship [the on-board computer] functions rapidly. For example, during rendezvous and docking with the station it not only processes information from the docking system, but also determines the necessary thrust of the propulsion system. Thus, because the computer is capable of executing hundreds of thousands of operations per second, it can almost instantaneously analyze a complex situation and find the optimal resolution.

The introduction of this type of computer on board a spacecraft marks a new stage in the development of manned ships. The "brain" takes upon itself the most difficult and least imaginative tasks.

Before flight cosmonauts must pass exams. A strict commission is interested in knowing how well the crew knows an enormous amount of digital parameters indicating the functioning of one or another system. The crew must memorize all of them. And technical documentation sent into space is so much that it weighs several kilograms. And it is not by accident that communications sessions between earth and orbit are executed through transmissions of digital information. And now all of this is stored in the computer's memory. In fact it has two memories -- long-term and operative. Before the commander of the craft is a small screen on which all necessary data is displayed. The "picture" on the screen is also transmitted to the Flight Control Center.

The "brain" makes it possible to qualitatively change flight control. Now the space ship is more independent and must not be monitored every second by the ground. Whereas formerly all calculations were performed by ground-based computing centers, now they are all done in orbit. And this means that any necessary maneuver in space can be implemented more rapidly.

I spoke with the designers of the ship's computer:

"To be honest, we had a few tranquil months," said one of them. "Usually we are on call, that is, if they have any problems. But we were not

called even once to the Flight Control Center, and this for us was the highest possible mark for the computer. Into the on-board computer went all of our experience in working in space. We tried to make it reliable, as "life-like" as possible. The computer is constructed such that it is constantly fighting for its life -- it looks for ways out of any difficulty. There were no failures in the system."

During ground tests conditions to be expected in actual flight were simulated. Once those conducting the trials imposed ten failures on various channels, but the computer continued to function. Space operations are highly demanding, and therefore, each component of the computer underwent strict quality control. Every seal was examined under a microscope, and the entire unit was tested component by component. Then every subassembly, individual unit and finally the system as a whole were carefully checked. In addition, throughout the year there were tests of the critical operation modes.

"Our computer required a new component base," continued the designer of the computer. "That meant the involvement of industry. This happened rather easily inasmuch as scientists, designers and industrial workers cooperated together. And this interaction was beneficial. The principles of reliability and optimization and the original designs that arose during the planning and production of the computer are now already being implemented in other aspects of electronics. The value of space research must be rated not only on the basis of what can be done in orbit, but rather on its impact on the development of science and technology as a whole as well. As far as this experience is concerned, we can confirm that achievements in space can contribute greatly to earth applications."

New Soyuz-T Descent Scheme

Moscow PRAVDA in Russian 27 Mar 80 p 6

[Article by V. Guberev: "One Hundred Days of Tests"]

[Excerpt] "We are conducting one of the final tests," commented Deputy Flight Director V. Kravets. "In space it is necessary to reserve every gram of fuel. And yet fuel is consumed in braking the crew compartment even though it will burn up in the atmosphere. Irrational, is it not? The design of "Soyuz-T" accounts for the possibliity of separating the unnecessary compartment already in space, which makes it possible to conserve rather a lot of fuel. Thus, only the descent module and the instrument compartment are braked . . . "
[307-P]

RYUMIN REPLACES LEBEDEV IN SOYUZ-35 CREW

Moscow TRUD in Russian 13 Apr 80 p 3

[Article by I. Melenevskiy: "Settling into the Space House"]

[Excerpt] The flight engineer [Valeriy Ryumin] is holding up well. And now, perhaps, it is time to tell in more detail just how he came to be aboard the station again. Valeriy Ryumin was not originally a member of the "Soyuz-35" crew. The crew had consisted of Leonid Popov and another cosmonaut, Valentin Lebedev, who had flown together with Petr Klumuk on "Soyuz-13" in 1973. But the unexpected occurred. During practice on a trampoline, Lebedev suffered a knee injury. An operation was necessary, and Lebedev was removed from the roster of cosmonauts preparing for flight. Who should be included in the crew [with Popov] in his place? One of the back-up crew members, or a novice?

How did the flight directors arrive at the candidacy of V. Ryumin? Indeed, he had returned from an extended orbital mission not long before. But they had quite significant reasons.

Ryumin had been actively participating in the training of the crew as an instructor. Not much time was required to prepare him for the flight. In one sense, he had been in training for the flight program for 175 days while aboard the orbital complex. And, what is more, the flight engineer knew the station well, was well aware of the station's condition, and had, in fact, prepared the list of necessary repair and maintenance operations to be conducted on "Salyut-6".

The well-executed docking and first days of work in space have confirmed the validity of the flight directors' decision.
[304-P]

YEGOROV COMMENTARY ON COSMONAUTS' MEDICAL STATUS

Moscow TASS in English 1107 GMT 16 Apr 80

[Text] Moscow, April 16, TASS--The first week of Leonid Popov's and Valeriy Ryumin's stay in outer space has come to an end. A TASS special correspondent interviewed Doctor of Science (Medicine) Anatoliy Yegorov at the Mission Control Center.

"We are pleased to see that our patients in outer space feel well and their capacity for work is not affected," the doctor said. "They are adapting to weightlessness even more quickly than we expected. First of all, mention should be made of the good condition of the 'newcomer' to outer space, Leonid Popov. This is a result of his thorough personal preparation for the experiment. Weightlessness is not new to Valeriy Ryumin who made a 175-day flight in the past year.

Is not the interval between the two space flights a bit too short for Valeriy Ryumin?

"No, it is now," Yegorov replied. "Before we, medics, gave permission for Ryumin's new flight the cosmonaut was thoroughly examined. We did not discover in his organism any residual effects from his almost half-a-year flight in outer space. He is quite well and the first week of the present flight is the best proof of this."

"The cosmonauts have already started their exercises on the running track," Yegorov said. "As you know our motto is: 'When on earth prepare for weightlessness and when in outer space do not forget about your return to the earth and about your meeting with the earth's gravitation."

Is there anything new in the matter of preventing unfavorable effects of weightlessness on space travellers?

"Yes, there is some," Yegorov said. "It is known, for instance, that on earth the greater part of the blood is in the lower part of the human body while in conditions of weightlessness blood is evenly distributed

throughout the organism. This causes a rush of blood to the head. Medics have devised special cuffs which are being used in this flight. The purpose of these cuffs is to ensure a roughly terrestrial distribution of blood in the organism. We have great hopes for this device. Later, we shall report on this experiment in greater detail."

In conclusion Yegorov said that the cosmonauts have accomplished a great amount of repair and prophylactic work as well as loading and unloading operations in connection with the ship Progress-8. "Leonid Popov and Valeriy Ryumin are working in some respects ahead of schedule. This is the most convincing proof of their physical well-being," the doctor said.
[308-P]

LASER RANGEFINDER IN LATVIA TRACKS SATELLITES

Moscow VOZDUSHNYY TRANSPORT in Russian 11 Mar 80 p 4

[TASS Report: "Laser -- Space Rangefinder"]

[Text] The astronomical observatory of the Latvian University has begun routine observations of artificial earth satellites using a laser rangefinder.

The distance to vehicles in orbit can now be determined with an accuracy of 1-2 meters. These measurements are necessary for calculating deviations in the earth's rotation, shifting of its poles and continental drift as well as for large-scale geodetic research.

"In preparation for the establishment of a new stationary service, we have already conducted more than 1,500 such observations," said K. Lapushka, a senior scientist at the observatory. "The equipment, which is constructed on the basis of Soviet-made components, is functioning reliably. It makes it possible to throw a concentrated narrow beam at relatively small satellites that are several thousand kilometers from the earth." [306-P]

SECOND-GENERATION GRAVITATIONAL ANTENNA SENSOR

Moscow VESTNIK MOSKOVSKOGO UNIVERSITETA, SERIYA 3, FIZIKA, ASTRONOMIYA in Russian Vol 20, No 5, 1979 pp 87-90

[Article by V. B. Braginskiy, Yu. B. Lanin and V. I. Panov, Department of Physics of Oscillations, Moscow University]

[Abstract] The creation of a second generation of antennas for the reception of gravitational radiation of extraterrestial origin requires the availability of a sensor of small oscillations capable of registering detector oscillations at a frequency $\omega_a \sim 10^3$-10^5 sec^{-1} with an amplitude $\Delta x \sim 10^{-17}$-10^{-19} cm (see V. B. Braginskiy, et al., PHYSICS REPORTS, 46, No 5, 1978; V. B. Braginskiy, et al., PRIBORY I TAKHNIKA EKSPERIMENTA, No 1, 234, 1977). The main difficulty arising in the development of such a sensor is the need for maintaining the gap between the sensor and the antenna with a high accuracy Δd so that in the presence of seismic noise the signal from the pump oscillator is held on the resonance curve slope of a capacitive converter. The reaction of the sensor to seismic noise can be substantially reduced by using an antenna design proposed by V. B. Braginskiy, et al. (PIS'MA ZhETF, 16, 157, 1972) jointly with a superconducting resonator of a special design as the capacitive converter (the proposed assembly is illustrated). This variant makes it possible to lessen the influence of seismic noise during the registry of antenna oscillations by a factor of at least 10^4. Other advantages of this system are discussed. The employment of the proposed converter in general considerably simplifies measurements made in registering small oscillations of a gravitational antenna. Figures 3; references 6: 3 Russian, 3 Western. [121-5303]

MOSCOW SYMPOSIUM ON STUDY OF SOLAR WIND

Moscow VESTNIK AKADEMII NAUK SSSR in Russian No 10, 1979 pp 106-110

[Article by Doctor of Technical Sciences K. I. Gringauz]

[Abstract] An international symposium on "The Solar Wind -- Results of Direct and Radioastronomical Observations" was held in Moscow during the period 5-10 April 1979 under the sponsorship of the Interdepartmental Geophysical Committee of the USSR Academy of Sciences. The symposium was also attended by scientists from Hungary, Poland, United States, West Germany and Czechoslovakia. The symposium was opened with six introductory reports characterizing methods for studying the solar wind and the present status of information concerning them. These six reports dealt with the following subject matter: energy of the solar wind, its ion composition, fast and slow streams of the solar wind; simultaneous observations of the sun's magnetic field and the interplanetary magnetic

field; direct measurements of the parameters of interplanetary plasma; theoretical concepts and methods serving as a basis for radioastronomical methods for investigating the solar wind; data on the solar wind obtained from observations of cosmic rays; mean annual velocities of the solar wind obtained using geomagnetic indices. Other papers dealt with the following: spectrum of fluctuations of electron concentration; inhomogeneities of plasma and solar wind velocity in the region of its acceleration near the sun; fluctuations of concentration of solar wind plasma along communication lines with the "Venera" vehicles; radio scintillations of ground sources; three-dimensional characteristics of shock waves generated in interplanetary plasma by solar flares; scintillations of radio sources at one and at three points; direct investigations of the solar wind on space vehicles; distribution function for solar wind electrons; macroscale condensations in the solar wind. There was a round-table discussion of methods for investigating the solar wind. (Each of the reports is briefly summarized in this conference summary.) [90-5303]

SHATALOV COMMENTS ON WOMEN IN COSMONAUTICS

Vil'nyus SOVETSKAYA LITVA in Russian 19 Mar 80 p 4

[Article: "Cosmonaut: Is it Also a Woman's Profession"]

[Text] The prospects for the participation of women in space flights was the subject of a conversation between APN correspondent M. Vasil'yev and Twice HSU Lieutenant General Vladimir Shatalov, director of training of Soviet cosmonauts.

Vasil'yev: If one were to ask about the most interesting profession of the 20th century, cosmonautics undoubtedly would occupy first place. However, for the time being it is primarily the privilege of males. Vladimir Aleksandrovich, how do you explain the fact that after the flight of Valentina Tereshkova no women have participated in space flights?

Shatalov: One of the reasons is the inadequate comfort conditions aboard the spaceships. In comparison with out present-day standards, they were very small and cramped and the load on the human body during flight was quite great.

It cannot be said that space welcomed earthlings with open arms. With an increase in flight duration there is an increase in the effect of space factors on the human body. For example, after the 18-day flight of cosmonauts Andriyan Nikolayev and Vitaliy Sevast'yanov in "Soyuz-9" we discovered such changes in the cosmonaut body as a decrease in heart volume by 11-12% and a considerable decrease in muscle volume. Under these conditions we simply had no moral right to subject man's better half to such loads.

In the years which followed we gained a deeper understanding of the mechanism of the effect of weightlessness on man and a quite reliable method was developed for ensuring maintenance of performance in space. The work and rest regime of the cosmonauts was modified and new suits and new "gyms" in orbit were created.

The last 175-day flight of cosmonauts Vladimir Lyakhov and Valeriy Ryumin indicated that we have achieved major successes in contending with the effect of weightlessness. I think that after more prolonged flights the performance of cosmonauts will remain at the same level. However, it is probably virtually impossible to be sure that cosmonauts will return in the same condition as when they flew into space, just as here on earth, when going out to work in the morning it is difficult to count on returning home with the same work capability. Work is work. And nevertheless our capabilities have considerably expanded and our knowledge of space has become far deeper. This is already making it possible to look differently on flights of women. Konstantin Eduardovich Tsiolkovskiy, the founder of rocketry, long ago spoke of the conquest of space and its "habitation." It is simply impossible to visualize prolonged (such as a year or more) missions in orbit, expeditions on the lunar surface and sometime even on Mars, without women. This would be a sort of violation of human rights. And, indeed, women most likely would not forgive us for this.

Vasil'yev: What are the prospects for women participating in future flights?

Shatalov: We have been witnesses of the unprecedented flight of the "Salyut-6" second-generation orbital station, which has two docking units. This affords the possibility of sending manned and atuomatic transport ships into orbit, which has enormous importance from the point of view of increasing the effectiveness of space flights. The replenishment of expendable supplies and the possibility of replacing equipment which has worn out are increasing the useful life of a station. In addition, transport ships can deliver into orbit additional scientific equipment and change or broaden the research program.

That is that with respect to the technical aspects. But there is another aspect, morale. Transport ships carry to the cosmonauts letters from their friends and relatives, books, new films, musical recordings and important terrestrial additions to our "space" table in the form of fresh apples, tomatoes, onions, and so forth.

Thus, working conditions in orbit are becoming increasingly comfortable. And this trend to constant improvement in the conditions for orbital work is making it possible to view the participation of women in space flights optimistically.

Vasil'yev: How will the female body tolerate space?

Shatalov: The mechanisms of the effect of space on the male body are now clear to us. The three days of flight of Valentina Tereshkova, we assume, passed completely painlessly and there were no negative effects. It can be postulated that on more prolonged flights as well there will be no serious effects on women. But women nevertheless remain women and

therefore the test of the validity of this assumption will be practical experience. An increase in the duration of their flight will probably be very cautious, with careful investigations after each of them.

Vasil'yev: Are Soviet women now being prepared for space flights?

Shatalov: For the time being, no. But I think that they will not any longer stand for the dominance of males in space. I, as the director of training of Soviet cosmonauts, receive an enormous number of letters from women. In these letters the representatives of the fair sex manifest a lively interest in participation in space flights and they actively speak out for equal rights in space.

Vasil'yev: What age do you feel is the most acceptable for participation in orbital experiments?

Shatalov: Age is now a relative concept even here on earth, and this is all the more true in space. For those who are beginning their path into space these should be the years when man is healthiest, youngest and strongest. Speaking in technical language, when they have the greatest safety factor. On the other hand, those beginning to work in this field should not only have an adequate store of knowledge, but also have a definite experience with life. Therefore, I feel that the optimum age is approximately 24-25-26 year. But not more than 32.

However, if a person has graduated from the "space" school, and has also flown, then 30 and 40 and 50 years of age is still not the limit. We have had cosmonauts who have flown who were about 50 years of age. There have been cases when cosmonauts of this age have been prepared for the next flights. Thus, the retirement age for representatives of our profession for the time remains relative.
[267-5303]

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CSO: 1866

COMMENTARY ON SEMI-RIGID EVA SUITS

Moscow KOMSOMOL'SKAYA PRAVDA in Russian 19 Mar 80 p 2

[Article by P. Pelekhov]

[Abstract] In response to a reader's question, the article traces the history of Soviet space suit design in relation to the work performed by Soviet cosmonauts in open space. A. A. Leonov, the first cosmonaut to have exited from his spacecraft, describes the physical and phychological stress involved in an EVA operation. He, like Ye Khrunov and A. Yeliseyev, wore soft, airtight, thermally-insulated space suits with life support systems that were housed in separate backpacks.

At the present time space suits of the semi-rigid type are used. These suits, which have been used by the "Salyut-6" crews, incorporate many, but not all, of the features considered to be optimal. In this article they are described as "mini-ships" because they are stepped into and closed from behind rather than put on like the old soft-construction suits. The upper part of the semi-rigid suit is a continuous piece from the sealed helmet to a kind of cuirass made of a strong lightweight alloy; life support systems are an integral part of the suit, thus eliminating the cables and hoses that once connected the two. The new space suit is said to be more comfortable and more reliable than those used for earlier EVA missions, but their design continues to be modified and improved. [295-P]

UDC: 611.814.3-085.1:591.544]-08:599.322.4

FUNCTIONAL STATE OF THE POSTERIOR LOBE OF THE NEUROHYPOPHYSIS OF RATS FLOWN ABOARD THE KOSMOS-936 BIOSATELLITE (RESULTS OF MORPHOLOGICAL STUDY)

Leningrad ARKHIV ANATOMII, GISTOLOGII I EMBRIOLOGII in Russian No 1, 1980 pp 62-67 manuscript received 27 Jun 79

SAVINA, YE. A., and ALEKSEYEV, YE. I., Institute of Biomedical Problems, USSR Ministry of Health, Moscow

[Abstract] A comparative study was made of morphological signs of posterior hypophyseal lobe function in rats kept in weightlessness and exposed to artificial gravity for 18.5 days aboard the biosatellite. A total of 25 Wistar rats were used in space flight and ground-based model experiments. Hypothalamohypophyseal neurosecretion was evaluated on the basis of studies of serial sections of the hypophysis, measurement of neurosecretory corpuscles, determination of distribution of neurosecretory substance in fibers, density of neurosecretory substance as

related to pituicytes and blood vessels, with morphometry of Herring's bodies and pituicyte nuclei. It is suggested that neurohormonal secretions diminishes in supraoptic and paraventricular hypothalamic nuclei, and there is temporary impairment of vasopressin and oxytocin excretion from neurosecretory fiber endings at the early postflight stage, as a result of prolonged weightlessness. Artificial gravity of 1 G during orbital flight partially attenuated the effects of weightlessness. Figures 2; references 29: 18 Russian, 11 Western.
[248-10,657]

GREENHOUSES IN SPACE--HIGHER PLANTS IN CLOSED ECOLOGICAL SYSTEMS

Moscow AVIATSIA I KOSMONAVTIKA in Russian No 3, 1980 pp 36-37

MILOV, M., candidate of agricultural sciences, and RUSAKOVA, G., engineer

[Abstract] Research was done on selection of plants to be raised in the ecological system of interplanetary spacecraft, for the purpose of supplying nourishing food to cosmonauts, since food cannot be stocked for very long aboard spacecraft without losing its quality and levels of important nutrients. Growing methods tested were hydroponics, aeroponics, methods based on capillary forces unrelated to gravity and aerosol method. Synthetic fertile "soil" was developed on the basis of ion exchange resins. Tests are being made of a variety of plants, including untraditional ones as sources of fresh vitamin supplements and other nutrients, such as salad chrysanthemum, wild onion species, etc.; four groups were arbitrarily distinguished, according to predominant synthesis of a nutrient: protein, fats, carbohydrates and vitamins. Various reactions of plants to weightlessness, as well as other space factors are discussed, and future study of geotropism is suggested.
[247-10,657]

UDC 629.198.3

SELECTION OF TYPES OF LAUNCH VEHICLES TO IMPLEMENT SPACE RESEARCH PROGRAMS WITHIN A MINIMUM PERIOD OF TIME

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18 No 1, 1980 pp 63-70

[Article by V.P. Ofitserov]

[Abstract] Methods for the solution of problems involved in substantiating the selection of types of launch vehicles are examined with respect to the implementation of a space research program within a minimum peroid of time, both with and without constraints on the program's cost. Instances of single-use (expendable) and reusable launch vehicles are considered. An approach based on the ideas of dynamic programming is used and developed in the solution. The factors considered include the cost per payload unit as based on expenditures on research, design, and production. The derived algorithms can be used in the program at minimum cost and in minimum time; they are applicable to automated design systems for the solution of a number of problems. References 3: all Russian. [245-1386]

UDC 629.782

COMPARATIVE ANALYSIS OF TWO INFORMATION MODELS OF THE MANNED SPACECRAFT APPROACH PROCESS

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18 No 1, 1980 pp 32-37

[Article by I. P. Meshcheryakov, S. A. Minayev and M. A. Gorbonosov]

[Abstract] The discrete (digital) information model of the approach and rendezvous of manned spacecraft is discussed and compared with the previously considered analog model from the standpoint of probabilistic and statistical characteristics. It is shown that each of the two models has its advantages and disadvantages: the digital model assures greater precision of measurement of approach parameters and a much smaller number of errors at readout in the static mode, while the analog model assures a more graphic presentation of the ranges of "permissible" values of the parameters (relative distance, approach velocity, angular line-of-sight velocity, pitching and yawing angles). In the discrete system each parameter is represented by a character, 4 bits, and a dimension. It is shown that the analog information model of the approach and rendezvous process is prefereble to its digital counterpart, since it assures a higher probability of a successful approach operation, reduces the mean fuel consumption by a factor of 1.2 times, reduces the rms deviation of the

fuel consumption by a factor of 4.3 times and relieves the stress of the operator, owing to the greater simplicity and graphic presentability of information coding, greater information content of every induced parameter, convenience of specification of ranges of "permissible" values of parameters, and readily memorized correspondence between the directions of the deviation of controls and the orientations of the controlled parameters. In the case of the analog model, however, it is necessary to increase the precision of the presentation of values of approach velocity during the final ~2 km segment of trajectory. References 5: all Russian.
[245-1385]

UDC 629.78

CONTROL OF THE DESCENT OF A SPACE CAPSULE FROM AN AES ORBIT

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18 No 1, 1980 pp 57-62

[Article by N. N. Ivashchenko, Yu. P. Kulyabichev, N. A. Kritsyna]

[Abstract] Semiballistic capsules of various types are needed to deliver research and experimental material to earth from orbital space stations. On-board digital computers are used to compute the parameters of the descent trajectory. Owing to the constraints on the weight and size of the capsule, however, the capacity and complexity of the on-board computer are limited. Within the framework of these limitations, and with the object of reducing the needed bulk of heat-insulating coating, the descent trajectory should assure a minimum time of descent through the atmosphere onto a specified recovery area. The solution of this problem reduces to the problem of optimal control with constraints on phase variables and on control and is based on the "maximum principle." An algorithm for the computation of nominal trajectory and nominal control corresponding to minimum target-reaching time is proposed. The algorithm can be utilized in the optimization of a broad class of nonlinear systems with constraints on phase variables and control. The suitability of the algorithm is verified by solving the problem of optimal rapidity of action for a system of five differential equations describing the motion of a capsule in the vertical plane. Figures 2; references 6: all Russian.
[245-1386]

UDC 525.7

UTILIZATION OF THE DYNAMIC MODEL OF THE ATMOSPHERE IN CALCULATING FLIGHT BALLISTICS FOR THE SALYUT-4 ORBITAL SPACE STATION

Moscow KOSMICHESKIYE ISSLEDOVANIYA in Russian Vol 18 No 1, 1980 pp 45-48

[Article by V. D. Yastrebov and I. D. Yegorov]

[Abstract] The usefulness of dynamic models of the atmosphere is sometimes questioned in view of the broad use and simplicity of static models, for which density is solely a function of the flight altitude of the space vehicle. To resolve this question, the practical experience gained in using the dynamic models in motion prediction problems relating to the "Salyut-4" orbital space station was examined. To this end, the dynamic model of the atmosphere was used in the algorithms for the problems of orbit determination according to navigational measurements and prediction of motion. Furthermore, a model of the earth's gravitational field with allowance for all the harmonics up to $n = m = 4$ was used in the algorithms. Parallel calculations were performed on the basis of static models of the atmosphere for purposes of comparison. It is concluded that the use of the dynamic model of the atmosphere results in a marked increase--doubling--in the accuracy of prediction as compared with the accuracy assured by the static model. Then, moreover, the ballistic coefficient S was more stable and corresponded more closely to the real state of the atmosphere: this is demonstrated by, in particular, the virtually zero mean deviation of prediction errors for the dynamic model, as used in the solution of the principal ballistic problems in the course of the flight of "Salyut-4." References 6: 5 Russian, 1 Western. [245-1386]

PROBLEMS IN INVESTIGATING THE EARTH'S NATURAL RESOURCES BY SPACE METHODS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 7-13

[Article by A. V. Sidorenko, Vice President USSR Academy of Sciences]

[Abstract] This is the introductory, review article in the first issue of the new USSR Academy of Sciences journal ISSLEDOVANIYE ZEMLI IZ KOSMOSA (Investigation of the Earth from Space). The journal is dedicated to the study, effective use and conservation of the natural resources of the USSR. After reviewing some of the programs being carried out in the USSR for studying natural resources, the author notes that the USSR Academy of Sciences has laid out a scientific program for long-range investigations for the period up to 1990. Five fundamental problems have been defined: 1. Development of methods for solving the most important problems in study of the earth from space; 2. Development of aerospace methods for studying agricultural resources; 3. Determination of interrelationships of spatial-energy characteristics of radiation of terrestrial features with their types and states; formulation of models of change in radiation characteristics under the influence of external conditions and internal transformations of the investigated features; 4. Study of the earth's radiation field and determination of the interrelationships among the parameters, anomalies and variations of this field and different geological-geophysical and natural-climatic processes transpiring beneath the earth's surface, at its surface, in the ocean and in the atmosphere; 5. Improvement in the methods and technical means for the processing and interpretation of aerospace information concerning the earth. (Each of these problems is briefly discussed.) The publication of this new journal, it is believed, will encourage further development of the natural sciences.
[270-5303]

PROBLEMS IN INVESTIGATING THE ENVIRONMENT FROM MANNED SPACESHIPS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 14-24

[Article by B. V. Vinogradov and USSR Pilot-Cosmonaut V. I. Sevast'yanov, Leningrad Division Institute of Oceanology]

[Abstract] The principal directions in the study of earth from space include: a) investigation of theoretical problems, such as the laws of formation of a space image, b) solution of methodological problems, such as improvement of interpretation methods, c) solution of practical problems in the use and conservation of natural resources. The principal experimental scientific method for the solution of theoretical problems in the study of the earth from space is the implementation of subsatellite experiments. There are various problems involved. Spectral generalization is a complex process of generalization of optically diverse details

on the earth's surface in the formation of one element of a space image or a cluster of such elements necessary for recognition of a feature on the basis of spectral characteristics. Geometrical generalization is the still more complex process of generalization of physically diverse mosaics of contours and boundaries of natural formations in the forming of a space image. The study of the natural conditions for a space survey includes an analysis of the influence of seasonal, weather and diurnal conditions on the nature of images of natural formations. The principal method for investigating these problems is the study of frequency-spectral, frequency-spatial and frequency-temporal distributions of optical and radiation inhomogeneities on the earth's surface. Improvement in interpretation methods essentially involves solution of three problems: preparation of keys, extrapolation and verification of remote data. The practical problems in investigation of the environment from space include recognition of the composition, structure, rhythm and dynamics of geosystems. At present the best-developed practical direction in investigations from space vehicles is the study of spatial structures in the environment and thematic mapping from photographs obtained from the "Soyuz" spacecraft and later from "Salyut." Mapping has been at scales of 1:100,000-1:10,000,000. The most effective mapping scales are evidently 1:300,000-1:3,000,000. The study of dynamics of the environment is the most timely thematic direction. A new and in the future possibly the leading direction in investigations from space vehicles is ecological monitoring of the state of the environment for environmental conservation and detection of anthropogenic effects. A special problem is the evaluation of the efficiency of using the space method. In addition to evaluating the economic efficiency (whether it is cheaper), it is necessary to ascertain the methodological and practical efficiency (whether it is better and more rapid). The different approaches to evaluating economic efficiency are discussed. Figures 5; references: 22 Russian. [270-5303]

GLACIOLOGICAL INVESTIGATIONS AND EXPERIMENTS ABOARD THE "SALYUT-6" ORBITAL STATION

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 25-34

[Article by L. V. Desinov, G. A. Nosenko, USSR Pilot-Cosmonaut G. M. Grechko, USSR Pilot-Cosmonaut A. S. Ivanchenkov and V. M. Kotlyakov, "Priroda" State Scientific Research and Production Center]

[Abstract] There is a need for establishing a ground-aerial-space service for observations of snow and ice, on a continuous basis monitoring the snow cover, sea ice, mountain and continental glaciation, and evaluating their reserves, variability and contamination. A block diagram of such a service is given and discussed. The ground part of the service is a network of permanent stations for glaciohydrometeorological observations

in accordance with a special program, periodic observations and measurements on specially selected glaciers and expeditionary investigations. The aerial part is for making visual observations, photography, surveying in the IR and microwave spectral ranges from aboard an aircraft or helicopter equipped as a flying glaciological laboratory; the following problems can be solved by remote aerial investigations: computation of snow reserves, evaluation of fluctuations of glaciers and measurements of their thickness, study of the physical properties and structure of glaciers, detection of liquid water within and underneath glaciers, evaluation of the thermal balance of the snow and ice surface and observations of sea ice and icebergs. The space part of the service involves a multizonal survey of various sectors of the earth's surface from artificial earth satellites and orbital stations as well as visual-instrumental observations of snow and ice phenomena. Such observations were made for the first time in 1978 by two expeditions aboard the "Salyut-6". This article outlines this experience. Visual observations were made using binoculars. The scales of photographs taken from flight altitudes of about 350 km were 1:2,000,000 and 1:5,000,000, the surveyed features sometimes being far from the subsatellite point and in most cases the photographs were oblique. In the first observations emphasis was on the Pamir region. Other glaciological observations were made in South America and Africa. Subsequent emphasis was on study of the dynamics of mountain glaciers and their surface morphology. Specific information is given on some of the observed areas, such as O'Higgins, Moreno and Braggen Glaciers in South America. These first two stages in the "Salyut-6" glaciological experiment have been successfully completed. They indicate that space observations are extremely important in broadening glaciological research. Figures 5; references: 2 Russian.
[270-5303]

DEVELOPMENT OF METHODS AND FACILITIES FOR SUBSATELLITE OBSERVATIONS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 35-39

[Article by T. K. Ismailov, Institute of Space Investigations of Natural Resources, Azerbaydzhan Academy of Sciences]

[Abstract] The basis for comprehensive subsatellite investigations is synchronous or quasisynchronous implementation of remote and surface investigations in control-measurement polygons, either over the land or over the ocean. The remote observations consist of space and aircraft ovservations which together with ground (ocean surface) investigations form a multilevel measurement scheme. The objective is to compare the data obtained at the different levels for studying objects and features at different scales, making it possible to upgrade the methodology for remote investigations. The refinement of such programs calls for the consolidation of a variety of goals. Such observations should be made

at different time scales, with different time intervals for each parameter or group of parameters. There should be a corresponding possibility for carrying out experiments covering various expanses, that is, with different spatial scales. A unified subsatellite measurement system must include all the necessary technical and programming means for the accumulation, transmission and processing of data and generalization of observational data. The first experimental variant of such a system has been created at the Institute of Space Investigations of Natural Resources of the Azerbaydzhan Academy of Sciences. The system consists of a ground data-measurement complex for contact and spectrometric measurements of environmental parameters and their primary processing and an aerial complex, remotely measuring these same parameters synchronously with the ground system. The experience in operating this subsatellite system in the polygons at the Azerbaydzhan Academy of Sciences' "Kaspiy" Scientific Center revealed that such work is highly effective and has made it possible to define further the problems in organizing subsatellite investigations. References: 3 Russian.
[270-5303]

DEVELOPMENT AND USE OF AEROSPACE INVESTIGATIONS OF NATURAL PHENOMENA AND RESOURCES IN SIBERIA AND THE FAR EAST

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 40-48

[Article by A. L. Yanshin and L. K. Zyat'kova, Institute of Geology and Geophysics Siberian Department USSR Academy of Sciences]

[Abstract] At the Computation Center and Institute of Automation and Electrometry Siberian Department USSR Academy of Sciences centers for the processing of aerospace information have been organized for the collective use of high-speed computers. The work of these centers is coordinated by the Council on Aerospace Research of the Presidium Siberian Department USSR Academy of Sciences with the objective of automated analysis and processing of photographs for the comprehensive interpretation of photographs of specific regions of Siberia with characteristic tectonic, geological-geomorphological and landscape features. Several directions have been defined for space research covering Siberia and the Far East. The first direction emphasizes studies of the biological resources in these regions. The second direction is geological-geographic investigations on the basis of space photoinformation. The third is the use of aerospace photoinformation in investigations of the natural resources of Siberia and the Far East. Each of these fields of research is discussed. The implementation of the long-range program for exploitation of the natural resources of Siberia has required the Scientific Coordination Council on Aerospace Research to face important tasks in integrating and coordinating all the research conducted in the three directions mentioned above.

The first task is broadening comprehensive aerospace investigations and using computers and automatic processing for space photoinformation. The second task is the compilation of generalizing space photomaps on the basis of which, in turn, it will be possible to compile more precise space geological, space tectonic, structural-geomorphological and other thematic maps. The third task is the regionalization of Siberia and the Far East with respect to the conditions for the interpretation of aerospace photoinformation. The fourth task is the creation of aerospace polygons in Siberia and the Far East for ground subsatellite observations. References: 30 Russian.
[270-5303]

SPACE INFORMATION AND GEOLOGICAL INVESTIGATIONS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 49-54

[Article by V. N. Bryukhanov and V. M. Moralev, All-Union Aerogeological Scientific-Production Combine "Aerogeologiya" and Lithosphere Institute USSR Academy of Sciences]

[Abstract] Photographs from space surveys carry information which earlier was not taken into account in geological studies but which reveals important characteristics of structure of the earth's crust. In particular, space survey materials have revealed the extensive development of linear dislocations not always revealed by other methods and also annular (arcuate) structural elements of different size and genesis. The newly revealed features are now making it necessary to reexamine the long-accepted mechanisms of crustal formation. Features of this type of unusual significance are major lineaments and zones of lineaments extending for hundreds and thousands of kilometers and without significant displacement intersecting different geostructural regions and blocks. For example, in the USSR there are about 20 lineament zones with a meridional orientation which with an interval of 5-7° converge in a northerly direction and diverge toward the equator. The diameter of annular structures varies from a few to 500-700 km. In some cases there is a direct spatial relationship between these linear and annular structures. Highly important findings are expected from investigation of these features first revealed on space photographs. Space survey materials are being employed in regional geological survey work, in seismic regionalization, in hydrogeological, geological engineering and geomorphological investigations, in studies of areas of recent volcanism, in predicting and exploring mineral deposits. The greater the degree of generalization of the space image, the deeper are the zones of dislocations which can be detected from it. Using space photographs at different scales it is possible to recognize the structure of different horizons in the earth's crust. The compilation of fundamentally new space photogeological maps is now possible, and among other purposes, serve as a good base for metallogenetic and predictive maps,

including the prediction of the presence of petroleum and gas in different areas. Another effective method for analysis of the spatial distribution of ore mineralization, made possible by space photography, is the detection of intersections of linear lineaments with one another or with annular (arcuate) structures. Methods are being developed for geometrical analysis of lineament networks for use in predicting and exploring areas of ore mineralization. The geological nature of these structural elements is still unclear but their great ore-controlling importance is beyond question. As indicated in this review, the different directions in use of space information in geological investigations have been rather clearly defined. These are primarily an analysis of the global structure of the earth and the determination of the genesis and interrelationship of different geostructural elements, which should lead to a qualitatively new solution of problems relating to the history of the earth's development and the patterns of mineral distribution in the crust. References 18: 15 Russian, 3 Western.
[270-5303]

MODERN PROBLEMS IN SATELLITE OCEANOLOGY

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 55-63

[Article by B. A. Nelepo, Marine Hydrophysical Institute, Ukrainian Academy of Sciences]

[Abstract] The fundamental problems in modern oceanology include the creation of unified thermohydrodynamic models of the ocean-atmosphere system for a variety of spatial and temporal scales; the creation of models of ecosystems; the creation of physicochemical models of the transport and accumulation of substances in the ocean; the investigation of the patterns of spatial distribution of minerals on the floor of the world ocean, and especially in shelf zones; and the investigation of tectonic phenomena in ocean areas. The practical problems include prediction of wind waves, short-range weather forecasting, forecasting ocean conditions as required for navigation and fishing, long-range forecasting and forecasting of tropical hurricanes; prediction of biological productivity of various specific regions and the ocean as a whole for efficient use of its food resources; detection of areas of interest for commercial extraction of mineral resources; monitoring of ocean contamination and development of methods for contending with contaminants; detection of areas where minerals can be extracted from the sea floor; prediction of earthquakes and tsunamis. Such an enormous program can be implemented only by the use of artificial earth satellites alone or in a ship-buoy-satellite system. The use of satellites has afforded possibilities for studying hydrophysical parameters on an ocean-wide basis, and equally importantly, considering the rapid variability of many of these parameters,

the monitoring can be done on a continuous basis, in a way which is revolutionary in comparison with traditional methods. This review examines the state of the art with respect to the following: a) Temperature of the ocean surface (mesoscale variability; temperature anomalies; frontal zones and zones of strong currents; structure of the active layer of the ocean); b) Radiation balance of the ocean - atmosphere system (temperature of the near-water atmospheric layer; wind speed; atmospheric pressure; air humidity; current velocity and direction; ocean color); c) Investigation of ocean depths (skin layer; internal waves; subsatellite observations support). However, only the first steps have been taken in satellite oceanography. There is an immediate need for the development of new instrumentation and methods for processing and interpreting the measurement results. During the coming decade the practical value of satellite oceanography will be dependent on a reasonable combination of new and traditional research methods. Space vehicles will not replace scientific research ships and buoy systems, but nevertheless the next few years will see highly significant results from their use. Figures 3, tables 1; references: 17 Russian.
[270-5303]

HOPES AND REALITIES IN SPACE OCEANOLOGY

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 64-78

[Article by K. N. Fedorov, Institute of Oceanology]

[Abstract] Despite the all-weather advantages of microwave methods, the most reliable remote means for measuring ocean surface temperature is and for a long time will be the IR radiometry method. Satellite radar altimetry is a new means for determining the instantaneous pattern of topography of the ocean surface, thereby making possible a qualitative and quantitative evaluation of tides, currents, eddies and wind-induced level changes. This review summarizes the accuracy required in oceanology for measuring the following: the geoid, ocean currents, meanders and eddies, water surface slopes near shores, tides, wind waves and tsunamis, storm and wind-induced level changes. This summary indicates that an orbital altimeter must meet high requirements in order to ensure accuracy in measuring these elements; the resolution must be about 10 cm. Appropriate instrumentation must be developed. Active radar measurements of the ocean surface using a radar with a synthesized aperture will evidently be an effective means for studying the state of the sea surface (waves), drift currents and wind parameters from an artificial earth satellite. Such an apparatus in principle should be a universal microwave complex combining all the operating regimes of a microwave radiometer, radioaltimeter, scatterometer and side-looking radar. Microwave radiometry evidently is an effective means for measuring the salinity of ocean

surface waters from aircraft and satellites; the most suitable range is apparently the region of wavelengths 20-30 cm. However, since on most fronts in the open ocean the salinity differentials rarely exceed 0.5 $^{0}/_{00}$, it must be admitted that remote measurements of salinity changes in the frontal zones of the world ocean for the time being are impossible. In the immediate future the best that can be expected is the discrimination of the interface between fresh and saline waters as well as well-expressed anomalies in the salinity field. Definite successes have been obtained in the following aspects of space oceanology: a) Observations of ocean eddies; b) Statistical analysis of eddies and fronts; c) Detection of internal waves; d) Use of satellites in systems including buoys; e) Use of information from satellites and orbital laboratories for guiding ships to features to be investigated. The review examines the solution of some new problems, such as aquaculture, and especially the global monitoring of climate. The solution of these and other problems by aerospace methods requires the implementation of a number of serious organizational measures. In particular, there must be a radical improvement in long-range planning and in the production of the necessary measuring equipment. Another important problem is the organization of a truly routine dissemination of the collected scientific data to interested institutes. Figures 5; refererces 50: 13 Russian, 37 Western.
[270-5303]

SPACE CARTOGRAPHY IN THE USSR

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 79-87

[Article by I. A. Kutuzov and Yu. P. Kiyenko, Main Administration of Geodesy and Cartography and the "Priroda" State Scientific Research and Production Center]

[Abstract] Space surveys of the earth have significant advantages over other methods for obtaining information for map compilation. The most important of these advantages is the areal coverage of space images. From satellites of the "Meteor" type the width of the surveyed zone is thousands of kilometers, whereas from stations of the "Salyut" type the photographed zone has a width of 450 km. In a short time an enormous area can be photographed; for example in five minutes a survey of a million square kilometers can be made from an orbital station. Due to the high position of the center of projection the central projection in which the image is constructed becomes close to orthogonal and this makes it possible to simplify a number of processes in photogrammetric work in map production. Space surveying has led to the development of a new direction in cartography -- the dynamic mapping of different processes and phenomena which vary with time. These include processes of anthropogenic influence on the formation of landscapes, development of the

vegetation cover, soil erosion, state of water bodies and shorelines, changes in the boundaries of natural zones and plant associations, state of glaciers in the mountains, etc. The inaccessibility of areas has lost its importance and remote, unpopulated areas can now be surveyed safely, quickly and inexpensively without the organization of time-consuming, arduous expeditions. In the USSR such areas include the Pamir and Tien Shan, Chukotka and Novaya Zemlya, the Kurile Islands and deserts of Central Asia. Probably the most productive use of space photography is the documentation of the natural resources in the investigated areas. In 1979 more than 400 organizations in the USSR and thousands of scientists and specialists were making use of such space information. The number of users is constantly increasing. It is essential to organize an automated system for exploiting the vast quantities of information which is becoming available so that the national economy will have new data on the country's natural resources and information for planning and monitoring the processes of their use, conservation and reproduction. Figures 4.
[270-5303]

THEMATIC INTERPRETATION OF MULTIZONAL SPACE PHOTOGRAPHS

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 88-94

[Article by Yu. F. Knizhnikov and V. I. Kravtsova, Geography Faculty Moscow State University]

[Abstract] A multizonal survey involves simultaneously taking a series of photographs in several narrow zones of the EM spectrum. The visible and near-IR ranges, divided into 4-6 zones, are now used for a multizonal survey from space vehicles using photographic or optical-mechanical scanning systems. The multizonal principle also gives a positive effect in the radio range when radiation with different frequencies and polarizations is registered. With respect to many interpretable features a set of zonal photographs is more informative than photographs in a single broad spectral range. A series of zonal photographs makes it possible to use the additional interpretation cr terion of the spectral signature, in a definite way dependent on the brightness of features in different spectral zones. In the optical range multizonal photographs make it possible to carry out photometric determinations by finding the relationship between the spectral signature and the spectral brightness of features. The multizonal survey principle affords definite possibilities for solving the problem of automation of interpretation. Although the multizonal method has a number of difficulties and shortcomings, the positive results far outweigh the negative aspects. Considerable experience has now been accumulated in the use of multizonal photography. It has been used aboard a number of Soviet and American space vehicles. There are several approaches to the practical use of multizonal photographs: 1) interpretation of a sample zonal photograph, 2) interpretation of color synthesized

photographs, 3) successive interpretation of a series of zonal photographs, 4) comparative interpretation of a series of zonal photographs using the spectral signature of surveyed features. The first of these is simple but does not have all the advantages of a multizonal survey. The second is extremely universal and is applicable for many types of thematic mapping. The third, and especially the fourth, are not being used very extensively but they make maximum use of the advantages of a multizonal survey. The fourth approach also opens the way to automatic interpretation of photographs. The use of the spectral signature is discussed. It is particularly applicable in the study of vegetation, unwooded forms of permafrost thermokarst relief, agricultural crops, some types of soils and exposed rocks. A multizonal survey is unusually effective in the study of water features. Figures 4; references 11: 10 Russian, 1 Western. [270-5303]

REMOTE METHODS FOR STUDYING THE EARTH'S SURFACE AND ATMOSPHERE IN THE MICROWAVE RANGE OF RADIO WAVES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 95-105

[Article by N. A. Armand, Institute of Radio Engineering and Electronics USSR Academy of Sciences]

[Abstract] The use of the microwave range of radio waves for observing the earth from space considerably supplements optical and IR observation methods and in some cases is superior to these methods. The advantages are attributable to the specific properties of the interaction between microwaves and the environment. Radio waves in the centimeter and especially in the decimeter ranges are virtually not absorbed and are not scattered by clouds, so that these radio observations can be considered all-weather. Due to the relatively small absorption in the ground, snow and ice, radio observations make it possible to "look" into the earth, in the future to depths of several tens and possibly hundreds of meters. In some cases observations in the radio range make it possible to avoid the screening effect of vegetation. Active and passive methods are discussed, including the fundamental physical principles. The results of a number of experiments are presented. Together with the data obtained by other methods, the data from radio observations can be used in meteorology, oceanography, in the study of ice and snow covers, in geology, agriculture and forestry, land improvement, water management and other fields. Appropriate instrumentation will be carried aboard both satellites and aircraft. A major problem in this field is that of spatial resolution. At present this resolution is inadequate and must be increased by considerably enlarging the antenna to several tens of meters or by employing special methods for shaping and processing signals, which is not possible in all cases. In the immediate future the microwave range will be used in

observing sectors of the earth with large scales of spatial (including statistical) uniformity, such as the surface of the ocean, ice and snow cover, extensive forests, steppe and desert zones. Figures 11; references 6: 5 Russian, 1 Western.
[270-5303]

SPECTRAL REFLECTIVE CHARACTERISTICS OF NATURAL FORMATIONS AND THEIR USE FOR REMOTE INVESTIGATION OF THE EARTH

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 106-113

[Article by D. N. Mishev, Central Space Research Laboratory Bulgarian Academy of Sciences]

[Abstract] The Central Space Research Laboratory of the Bulgarian Academy of Sciences is carrying out scientific work in the field of aerospace measurements of the spectral reflective characteristics (SRC) of natural formations and their use for the classification and recognition of terrestrial features and their state. The studies involve the methods and instrumentation for measuring the SRC of natural formations and methods and instrumentation for processing the results of measurement of the SRC and classification of features for solving a number of problems in the earth sciences and the national economy. Emphasis has been on developing instruments for measuring the SRC in situ and aboard aircraft laboratories and space vehicles. A series of field spectrometers has been developed: ISOKh-010, ISOKh-020 and ISOKh-022. These are 20-channel instruments operating in the range 400-800 nm. They have high operational characteristics, a minimum weight (less than 1.5 kg) and a high reliability. The ISOKh-010 and ISOKh-020 have been used extensively in synchronous subsatellite, subaircraft and in situ measurements organized in collaboration with the USSR Space Research Institute in 1975, 1976, 1977 and 1978 in Bulgarian polygons during surveys from a Soviet AN-30 aircraft laboratory. The "Spektr-15" satellite spectrometer, which operated successfully on the "Salyut" -- "Soyuz" complex, is a system for the collection and registry of data in 15 channels in the visible and near-IR ranges, ensuring a high accuracy in measuring the spectral brightness coefficient (SBC). The "Spektr-15" instrument consists of the "Spektr-15K" spectrometer proper and the "Spektr-15KR" recorder. A block diagram of this instrument accompanies the text and its structure and operating principle are discussed. Specialists in Bulgaria have also formulated a model of reflection of electromagnetic waves from the surface of natural features on the basis of allowance for the micro-structure of the reflecting surface. The spectral brightness coefficient of inhomogeneous features has been investigated. Investigation of the thermal inertia of natural features is another aspect of Bulgarian research. Studies have also been directed to a classification analysis on the basis of the spectral brightness coefficient. Work has been done on discriminant analysis of natural

features on the basis of spectral reflective characteristics. Other investigations at the laboratory have dealt with the direct use of spectral brightness coefficients and their transformation. Figures 7; references 17: 7 Russian, 10 Western.
[270-5303]

POSSIBILITIES OF USING SOIL REFLECTION SPECTRA FOR STUDYING ITS PROPERTIES

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 114-124

[Article by K. Ya. Kondrat'yev and P. P. Fedchenko, Main Geophysical Observatory and All-Union Scientific Research Institute of Agricultural Meteorology]

[Abstract] This review is a discussion of the spectral reflectivity of soils and the possibility of using such data for reconstructing the properties of soils, the objective being the mapping of soil types and subtypes. Numerous Soviet and foreign publications have dealt with this subject; this review emphasizes laboratory investigations. The following subjects are discussed, drawing upon 32 sources in the literature: spectral reflectivity of soils in various geographic zones; factors influencing the spectral reflective properties of soils; quantitative relationships between spectral reflectivity of soils and their composition; recognition of soils on the basis of their reflection spectra. It now appears clear that the use of the spectral brightness coefficients of soils, measured in narrow spectral intervals, affords broad possibilities for mapping the soil cover. Application of the method will enable soil scientists to accelerate and rationalize the mapping of soils, thus eliminating the subjective factor, considerably reducing the amount of work involved, reducing costs, and most importantly, making it possible to compile soil maps for an extensive area in a short time. Nevertheless, at this time, despite several decades of studying the spectral properties of soils, only a small number of studies have yielded specific results. This has been true due to the lack of reliable spectrophotometric instruments suitable for use in the field and from aircraft. Moreover, there have been difficulties involved in making allowance for the principal factors exerting an influence on spectral reflective properties. Finally, soil scientists have lacked the necessary knowledge and skills in the field of photometry. These are problems which must be overcome.
Figures 1, tables 3; references 32: 29 Russian, 3 Western.
[270-5303]

FURTHER DEVELOPMENT OF METHODS FOR INVESTIGATING THE EARTH FROM SPACE

Moscow ISSLEDOVANIYE ZEMLI IZ KOSMOSA in Russian No 1, 1980 pp 125-133

[Article by Ya. L. Ziman, Space Research Institute]

[Abstract] Specialists at the Space Research Institute have developed a comprehensive program for further space investigations and experiments. It is proposed that the dynamic appr ach be used as the basis for the technological scheme for investigations of the earth from space. In addition to large-scale surveys for investigating local regions, work should be initiated on regular measurements and study of the field of the earth's spectral brightness and the spectral brightness of various individual regions for detecting the interrelationships of its parameters and variations of this field with geophysical and geographic processes and phenomena transpiring at the surface, in the atmosphere and possibly in the earth's deep layers. Surveys of various terrestrial formations must be made in different spectral zones with spectral and spatial resolutions optimum for the solution of specific problems. Spectral analysis of terrestrial formations using data from remote sensing must be combined with a structural analysis. Coordinate and radiometric standardization of the data collected from space is necessary. Two instrument complexes useful in solving the formulated problems are described. The first is a videospectrometric complex which can be used aboard aircraft and satellites operating in the 0.4 to 15 μm range. The complex can include two videospectrometers operating synchronously and in phase. The first operates in the visible and near-IR spectral regions whereas the second operates in thermal IR zones. The second instrument complex is for making a multizonal survey of the earth's surface simultaneously in several zones of the electromagnetic spectrum (as is done now) and in several zones of the spectrum of spatial frequencies. This complex includes four functionally different systems: optical scanning of the earth's surface, measurement of radiation intensity in different zones of the spectrum of spatial frequencies, coding, compression and transmission of video information. Figures 4; references: 5 Russian.
[270-5303]

COMMENTARY ON US SPACE-BASED ARMS PROGRAM

Moscow LITERATURNAYA GAZETA in Russian 12 Mar 80 p 9

[Article by Anatoliy Manakov: "Myths Feel Cramped on Earth"]

[Text] You really have to admit that initiative and zeal are not things that the Pentagon lacks. Especially now that the White House is giving it insistent orders, no longer encoded, to "build up," "deploy" and "react quickly" . . . . and you may be certain that the Pentagon will not hang around.

We will not simply make unsubstantiated allegations. Here are just a few of the most recent "enterprising suggestions" from the American defense department: Placing modified Minuteman-2 ICBMS in orbit in space; launching a large unmanned orbital facility for the Minuteman-3; developing a missile capable of being launched into space from a jet fighter. And those are only the projects that the press has reported, only part of the large-scale arms race toward which the military-industrial complex "eggheads" are with increasing persistence steering a course.

Here is a noteworthy fact--even quite recently officials in Washington would refuse categorically to discuss the topic of space weapons in the press, even anonymously. But today they are happy to talk about this without any provisos. Thus, for instance, it has been learned that 113 of the 487 space shuttle flights planned for the next decade are for purely military purposes.

Air Force Secretary H. Mark forecasts that the first Americans to go into space for long periods will certainly not be outstanding test pilots but electronics specialists. It will be part of their mission, in particular, to "examine other countries' satellites to find out how they work." Lt Gen T. Stafford, who heads research and experimental design work in the Air Force, develops the ideas of his boss and tells a broad audience, in equally vivid terms, of a future fleet of two-man spaceships capable of taking off from ordinary airfields and landing at their base after performing missions in space. In Stafford's opinion, such a fleet, equipped with laser weapons, could join the arsenal even before the end of the 20th century.

Why, are all these lethal marvels being conjured up? U.S. NEWS & WORLD REPORT, in whose pages the aforementioned military men have been featured, asked them that question too--in a somewhat different form, it is true: "Will the U.S. Air Force in time conduct military operations outside the atmosphere?" To which an equally laconic reply was received: "Wherever there are things of value, people will fight for them." Let us nevertheless submit just one amendment, and at the same time introduce a little clarity. The Pentagon's space projects made their appearance some time ago. In the past 20 years, according to available American estimates, the United States has spent more than $50 billion on military purposes in space. All this, Washington assures people, was "pretty fragile equipment designed only to support ground operations." Much greater funds will be required to create the new, combat-effective means of space warfare that the Pentagon is advocating. Funds that are obviously so great that the department's leaders have now decided to mentally prepare the public, via the mass media, for another increase in military spending. The myth was finding things cramped. If you're going to scare the Americans, people in Washington think, why not do it from space. So, without any pangs of conscience, they catapult beyond the clouds the artificially fueled fear of the nonexistent "Soviet threat"--after all, it's much more difficult to verify the threat up there than it is on earth.
[298-P]

COMMENTARY ON US MILITARY SPACE PROJECTS

Moscow KRASNAYA ZVEZDA in Russian 19 Mar 80 p 3

[Article by G. Sibiryakov and A. Khabarov: "In a Dangerous Orbit: United States Accelerating the Development of Space Weapons"]

[Text] In terms of the level of appropriations, the sophistication and level of technical equipment of the industrial base and employment of a highly skilled work force the U.S. space program ranks only below arms development and manufacture. Total U.S. spending on space has already topped $100 billion; more than 500,000 scientists, engineers, technicians and workers in one of America's major sectors--the aerospace industry--are now working directly on space projects.

Space projects are at the center of attention of the state's pol tical leadership, the military department and big monopolies. Foreign commentators associate the military reorientation of the entire American space program with the Carter administration's occupancy of the White House. It is a question of accelerating the development of space weapon systems such as killer satellites armed with homing shells; laser arms and weapons utilizing beams of elementary high-energy particles, and so forth. The purpose of these plans has been formulated with cynical frankness in America's BUSINESS WEEK magazine: "Whoever can seize control of space--that main areas of future wars--will be able to change the correlation of forces so decisively that it will be tantamount to establishing world supremacy."

It must be said that the proportion of military space projects was quite large even in the past: According to the official assessments of C. Sheldon, leading American specialist of the U.S. Library of Congress Research Service, approximately 60 percent of all U.S. space launches were carried out in the interests of the Defense Department and more than 40 percent of all the money spent on space went on various military projects.

However, the military department is striving for more. The American "space" budget for 1980 totaled approximately $8.2 billion--a sum shared equally between the Defense Department and NASA. This amount, the biggest in 10 years (in 1972 it equaled $4.6 billion), evidently is not the limit. Experts of the American firm of Frost and Sullivan, who are well acquainted with the details of the backstage struggle for appropriations in Congress, have forecast an additional growth (by a further 65 percent) in appropriations for military space projects by 1981 against practically unchanged spending on work in the sphere of conquering space for peaceful purposes.

The reason for such an appreciable "list" toward the intensification of military space program should be sought, above all, in the policy of the Carter administration. As long ago as 1977 the President issued a special communique emphasizing that so-called "national security" problems are determining factors in the formulation of state policy in the sphere of space. This was followed by a decision to set up under the National Security Council an interdepartmental committee to draft recommendations regarding policy in the sphere of U.S. space programs. The most influential figure on this organ is Defense Secretary H. Brown. The committee includes the President's adviser on national securtiy affairs, representatives of the Defense Department, the State Department, the CIA, the Joint Chiefs of Staff and so forth. The list of "interested" parties alone is sufficient to judge the thrust and the activities of this committee.

In May 1978 the President adopted a decision based on the thesis that the Defense Department draw up plans to utilize civilian space funds for the resolution of military tasks.

In connection with these new American administration steps a number of U.S. press organs carried statements and proposals aimed at totally subordinating the whole American space program to the Defense Department.

NATION magazine, for example, called the separation of space projects into civilian and military--a division which has existed for 20 years--"an unnecessary luxury which the United States cannot afford," and called for the adoption of tough political decisions to insure the closer unity of these programs.

The joint development of the "space shuttle" reusable transport craft is named as an example of a "successful" step in this direction. The fact that the Defense Department really plays the dominant role in this project is evidenced, for example, by the fact that, against an overall reduction in the proposed number of "space shuttle" flights in 1980-1991, the number of flights in the Defense Department's interests remains practically unchanged and is even increasing. The present schedule provides that almost one flight in every four will be a military one.

The usually well-informed French magazine AIR ET COSMOS emphasizes that it is proposed to include in the very first 10 shuttle launches the delivery of several military communications and reconnaissance satellites into space, to test laser devices under Defense Department programs and to carry out a number of other projects with a clearly expressed military thrust.

The following question naturally arises in this connection: What is the main substance of the new stage which the American military space program could enter in the early eighties if measures are not taken, including measures in the sphere of international talks, with a view to preventing the development of the dangerous trends which have recently become apparent?

Until the mid-seventies the chief military-applied projects amounted mainly to insuring the armed forces' combat activities: They continued to use and improve air force and naval satellite systems for strategic and tactical communications, navigation (the Navy's Transit and Timation systems), reconnaissance (the first generations of Big Bird satellites) and geodesy (the Geos satellites) and conducted scientific research and development in the creation of new space technology, launch complexes and ground communications and tracking facilities for vehicles in space.

In mid-seventies, with the support of the Pentagon leadership and a number of politicians, the military-industrial corporations adopted a policy of the accelerated creation of space weapon systems in the desire to secure multimillion-dollar orders for new weapon systems.

The U.S. Defense Department has now developed a whole complex of programs for the creation of antisalellite arms. Among other pro ects a special place is occupied by the anti-satellite missile being created by the Vought Corporation. It has been mamed the MHV (miniture homing vehicle) and consists of a cylinder ringed with small missiles. It is proposed to launch this apparatus from on board an F-15 aircraft after rising to an altitute of 20-30 km. From there the "killer missiles" (as the American press calls them) will start seeking "targets" with the help of infrared sensors and an onboard computer.

Certain "brain trusts and planning bureaus," BUSINESS WEEK reports, are developing laser space weapon systems. The U.S. Defense Department has so far spent approximately $1.5 billion on experimental design work in this direction.

A version of "camouflaged" or "silent" satellites is also being considered. Vehicles of this sort will be "hidden" deep in space, where they will be "inactive" and, consequently difficult to detect until switched on at a command from earth. In short, the "space strategists" are feverishly hunting for new ideas.

U.S. political and military leaders cite the hackneyed thesis of the supposedly increasing "Soviet space threat" as justifying the need to develop space weapons systems, as well as the acceleration of the strategic arms race. However, the arguments and facts cited here, as foreign commentators themselves admit, appear unconvincing and most frequently prove to be simply spurious invention. This is how they are evaluated by the American missile engineer R. Aldridge in the article "Who Will Fire the First Shot in Space?" published in NATION magazine: "They have always tried to make the American reader believe that the Russians have the potential to destroy American space vehicles. However, it was precisely the Pentagon that developed anti-satellite systems in the sixties, and it has ambitiously been perfecting increasingly efficient interceptors for almost two decades."

Perry, U.S. under secretary of defense, recently declared in Congress that the United States is "making ever-increasing use of space systems for its armed forces."

Having embarked on the path of the race for not only ground but also space weapons, the U.S. administration, the Pentagon and the military-industrial complex are seeking to return the world to the period of the cold war and mutual suspicion so as to transfuse still more considerable resources into the military spheres. The consequences of such dangerous steps have had to be admitted by U.S. Secretary of State C. Vance, who once declared that "shifting the arms race into space would undermine the security not only of other countries but also our own security." However, there is no place for common sense where everything is subordinated to the policy of hegemonism and aggression.
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VERESHCHETIN OUTLINES UN CONFERENCE ON SPACE ACTIVITIES

Moscow ZEMLYA I VSELENNAYA in Russian No 1, 1980 pp 48-49

[Article by V. S. Vereshchetin, doctor of legal sciences and deputy chairman of the "Intercosmos" Council, USSR Academy of Sciences: "The United Nations and Cooperation in Space"]

[Text] In 1982, which will mark the 25th anniversary of the launching of the world's first artificial satellite, the Second UN Conference on the Exploration and Utilization of Outer Space for Peaceful Purposes will be held. The decision to convene the conference was made unanimously at the 22d Session of the UN Committee on Space, which met in New York from 18 June to 3 July 1979.

In accordance with a resolution adopted by the UN General Assembly back in 1961, the United Nations should be the center for international cooperation in the exploration and utilization of outer space for peaceful purposes. In the UN system, a special branch of the General Assembly was created in order to carry out this assignment. This is the UN Committee on Space, in which 47 nations with different social and political systems discuss political, legal, scientific and technical questions that arise during the conquest of space. Since 1962 the Committee and its two subcommittees (scientific-technical and juridical) have met annually.

The First UN Conference on the Exploration and Utilization of Outer Space for Peaceful Purposes, which was convened in 1968 at the request of the USSR, was a forum at which the representatives of 78 countries and 13 international organizations reviewed the results of the first decade of space exploration. It is expected that the Second UN Conference will attract an even greater number of participants. As at the previous conference, the basic attention at this one should be focused on the needs and requirements of the developing countries. The conference's agenda includes a wide circle of problems that will be discussed at the plenary meetings, as well as in three committees that are concerned with the following basic areas: the state of space science and technology;

its utilization; international collaboration and the role of the United Nations. The conference's work will be completed by the adoption of a report for the UN General Assembly that contains recommendations on the United Nations' further activities in the field of space exploration. The UN Committee on Space and its subcommittee on Science and Technology will prepare the draft of the final report.

For each of the problems that were discussed (except for the location of the conference), the UN Committee on Space adopted agreed-upon recommendations that were presented for approval by the next session of the UN General Assembly. The question of the conference's location must be decided at the next session of the UN Committee on Space, which will be held in the summer of 1980. The Soviet Union has proposed that the conference be held in Moscow in August 1982.

The 22d Session of the UN Comiittee on Space approved the draft of an agreement on the Moon. Its full title is: "Agreement on the Activities of Nations on the Moon and Other Heavenly Bodies." The Committee's release of this document for discussion by the UN General Assembly completed the development of a new agreement in the field of international space law, the first draft of which was introduced in the United Nations by the Soviet Union in 1971 (ZEMLYA I VSELENNAYA, No 4, 1978, pp 2-5).

The draft presented by the Soviet Union contained the following basic proposals:

--that the exploration and utilization of space be carried out with due consideration for the interests of the present and future generations of people;

--that, in accordance with the principles of the UN Charter, the use of force or the threat of force and any hostile acts be perpetration of such acts with respect to Earth;

--that the prohibition against the placement on the Moon of nuclear weapons and other weapons of mass destruction be confirmed and that other activities aimed at using the Moon for military purposes also be banned;

--that the exploration and utilization of the Moon be accomplished by means that ensure the prevention of unfavorable changes in and contamination of the lunar environment;

--that the surface and depths of the Moon not be the property of nations, any international organizations, or legal or actual persons;

--that nations will take all necessary measures for the purpose of guarding the life andhealth of people on the Moon.

The text approved by the UN Committee on Space incorporates all the mentioned proposals in the original draft presented by the Soviet Union. In addition, at the request of the developing countries the draft of the agreement includes the proposal that "the Moon and its natural resources are the common heritage of mankind" (Article 11 of the draft), and that it is the duty of the participants in the agreement to establish a international regime to control the exploitation of the Moon's natural resources when it becomes obvious that such exploitation is possible in the near future. In the development of this regime, special consideration must be given to the interests and needs of the developing countries as well as the efforts of the countries that directly or indirectly contributed to the conquest of the Moon.

Over the many years of discussion of the draft of the agreement on the Moon in the UN Committee on Space's Juridical Subcommittee, the Soviet delegation -- as well as those of a number of other countries -- assumed that the development of a legal regime for exploiting the resources of the Moon and other heavenly bodies was not urgent at that time and should be done with due consideration for the subsequent development of cosmonautics. Moreover, from the juridical point of view the concept of "the common heritage of mankind" is extremely vague and belongs more in the categories of morality and philosophy than jurisprudence. However, in order to achieve a sensible compromise while meeting the urgent desires of the developing countries, the Soviet delegations and others that share this viewpoint agreed to include the proposals listed above in the draft of the agreement. After approval of this draft by the UN General Assembly, the agreement will be offered for signing and ratificatio- by all nations and will take on the force of a new document in international space law.

The UN Committee on Space also discussed the results of the work done by its Scientific and Technical Subcommittee on the problem of the use of nuclear power sources in space. During the discussion of this problem by different UN agencies, several Western governments attempted to use an incident related to the falling of fragments of the Soviet "Cosmos-954" satellite over Canada in 1978. They tried to forbid the use of nuclear power sources in space or to establish international control over that type of activity although -- as is well known -- the further development of several important branches of cosmonautics is unthinkable without the use of nuclear power sources.

The UN Committee on Space confirmed the conclusion of its Scientific and Technical Subcommittee that when the necessary safety measures are observed, the use of nuclear power sources in space is quite possible. The Committee decided to continue the discussion of this question in a working group created by the Scientific and Technical Subcommittee. It recommended that its Juridical Subcommittee survey the existing international space law. It will then be possible to determine the feasibility of supplementing its proposals on the use of nuclear power sources in space.

The Committee also continued to discuss several other problems. Among them is the Soviet Union's earlier proposal on the legal demarcation between air space and outer space at an altitude of 100-110 km.

The recent 22d Session of the UN Committee on Space, which was held under the aegis of a Soviet-American meeting on the highest level and the signing of the SALT II agreement, was notable for the adoption of a number of important recommendations that will exert a considerable influence on the further development of international cooperation in the study and exploitation of space.

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BAKU CONFERENCE CENTERS ON REMOTE SENSING FOR NATURAL RESOURCES

Baku BAKINSKIY RABOCHIY in Russian 27 Mar 80 p 3

[Excerpt] A joint meeting of the bureau of the USSR Academy of Sciences' scientific council on problems of the biosphere and the bureau of the Academy's commission for the study of natural resources from space has concluded in Baku. The attention of participating scientists was focused on a number of questions, including the study of land relief and forests through the use of space-based sensing equipment, the use of space information to study glaciers, the movements of fish populations and the influence of solar activity on health, etc.

The following papers were read on the second day of the meeting:

-- "The First Steps in Studying the Earth from Space," by Academician I. P. Gerasimov;

-- "Aerospace Monitoring of the Dynamics of Ecological Systems," by Doctor of Geographical Sciences B. V. Vinogradov;

-- "The Advancement of Geophysical Research from Space in Azerbaydzhan," by Candidate of Physical-Mathematical Sciences T. A. Ismail-zade;

-- "The Physical-Technical and Technological Principles of Designing Subsatellite Information and Measuring Systems," by Doctor of Technical Sciences T. K. Ismaylov. Reports and papers were discussed.

The participants in the meeting visited the Institute of Natural Resource Studies from Space, the Institute of Geography and the "Geofizika" scientific center of the Azerbaydzhan Academy of Sciences, and they were made aware of projects being conducted at these scientific institutions and acquainted with their laboratory equipment.
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LAUNCH TABLE

Date	Designation	Orbital Parameters				Notes
		Apogee	Perigee	Period	Inclination	
27 Mar 80	Cosmos-1169	521 km	478 km	94.5 min	65.8°	
27 Mar 80	Progress-8	266 km	122 km	88.8 min	51.6°	Automatic freight transport ship launched 2153 hours Moscow time; Salyut-6 resupply mission
1 Apr 80	Cosmos-1170	386 km	181 km	89.9 min	70.4°	
3 Apr 80	Cosmos-1171	1,017 km	976 km	105 min	65.8°	
9 Apr 80	Soyuz-35	Initial parameters not reported				Manned by Flight Commander Popov and Flight Engineer Ryumin; docked with "Salyut-6" station
12 Apr 80	Cosmos-1172	40,160 km	637 km	12 h 6 min	62.3°	
17 Apr 80	Cosmos-1173	379 km	180 km	89.9 min	70.3°	
18 Apr 80	Cosmos-1174	1,035 km	387 km	98.6 min	65.8°	
19 Apr 80	Cosmos-1175	485 km	317 km	92.3 min	62.5°	
27 Apr 80	Progress-9	275 km	192 km	88.9 min	51.6°	
29 Apr 80	Cosmos-1176	265 km	260 km	89.6 min	65°	
	Cosmos-1177	365 km	181 km	89.7 min	67.2°	

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23 MAY 1980

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